



POLYMET
MINING

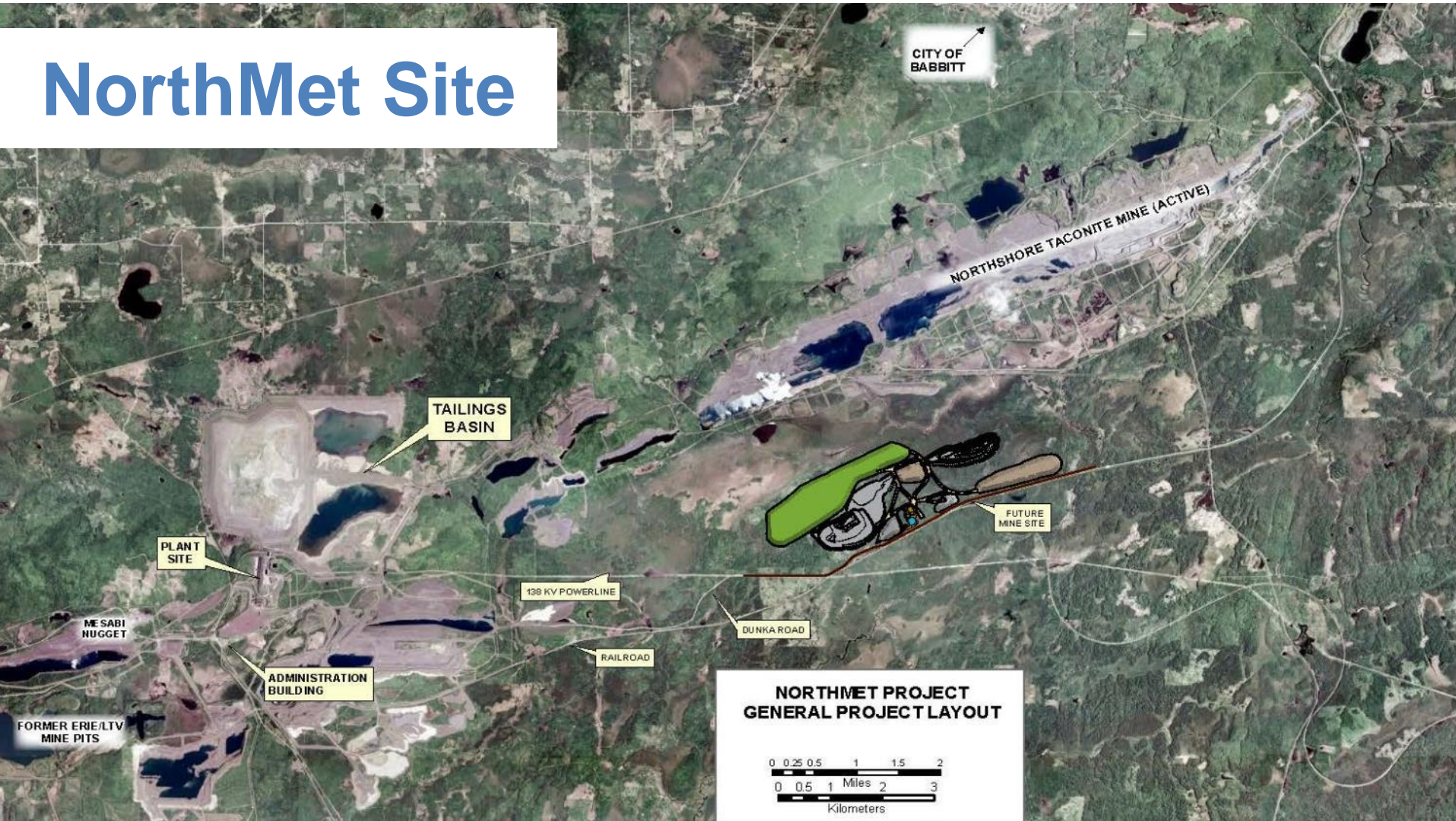
Data Collection for Environmental Management

**Presented to EPA
June 16, 2015**

Brad Moore



NorthMet Site



Environmental Data Collection

Focus on three examples of various data collection activities:

- Waste Rock Characterization
- Groundwater Quality
- Wild Rice Surveys



Waste Characterization

6/29/2015

PLM / POM

5

Waste Rock Characterization

- Extensive core database with >18,000 samples
- 82 unique waste rock samples for geochemical characterization and humidity cell testing
- Leachate collected and analyzed over ~10 years



Humidity Cell Tests

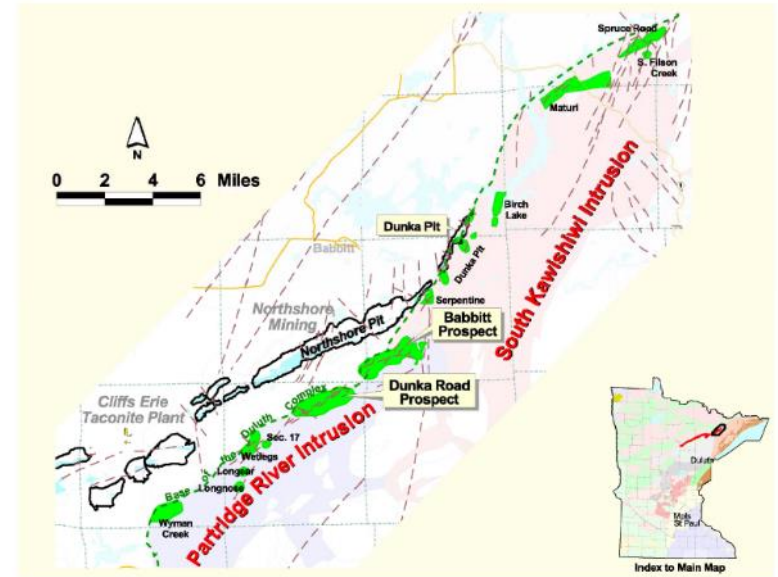
Provide information on constituent release rates

Rock Type	Original Tests	Earliest Start Date	Tests Continuing
Category 1 Waste Rock	37	August 2005	3
Category 2/3 Waste Rock	26	August 2005	4
Category 4 Waste Rock	22	August 2005	2
Ore	3	August 2005	1
Pilot Plant 1 Flotation Tailings	13	August 2005	3
Pilot Plant 2 & 3 Flotation Tailings	8	June 2008	3
Scavenger Tailings	12	October 2009	3
Borrow materials	5	August 2010	0

MDNR long-term monitoring and testing of Duluth Complex

- AMAX (Babbitt Deposit)
 - low-grade stockpiles (6)
 - 1978-1993: drainage
 - 1994: solids studied as piles dismantled
- Dunka Mine
 - DC stockpile drainage (6)
 - 1976-present
- Lab reactors/humidity cells
 - DC samples with variations in rock type, particle size, S content, etc.
 - duration of weeks-decades
 - comparison with field tests

Figure 1. Map of Duluth Complex mineral prospects.



From: Lapakko and Antonson, 2012, Duluth Complex Rock Dissolution and Mitigation Techniques: A summary of 35 years of DNR research



Baseline Groundwater Quality

Baseline Groundwater Quality

- **Characterize groundwater quality** in the unconsolidated deposits at the Mine Site to **develop probability distributions** for background groundwater quality in the water quality (GoldSim) model
- Probability distributions used to establish:
 - Baseline conditions used for comparison with estimated project impacts
 - Contributions from watershed areas not impacted by the project

Program Scope

- Network of 24 monitoring wells
 - 3 wells installed in 2005
 - 21 wells installed in 2011-2012
- Sample collection
 - Generally, three times per year (quarterly except 1st quarter)
 - Monthly sampling from November 2011 – August 2012
 - Field parameters + laboratory analysis for 60+ constituents (general parameters, metals)
 - Total of 421 groundwater samples collected to date

Challenges

- U.S. Forest Service Plan of Operations
 - Ground disturbance < 5 acres
 - Use existing roads/trails and cleared areas to the extent feasible
 - Avoid historic (Trygg) trail corridors, wildlife disturbance, and archeological sites
 - Crossing wetland areas with mechanized equipment limited to frozen conditions

Field Conditions

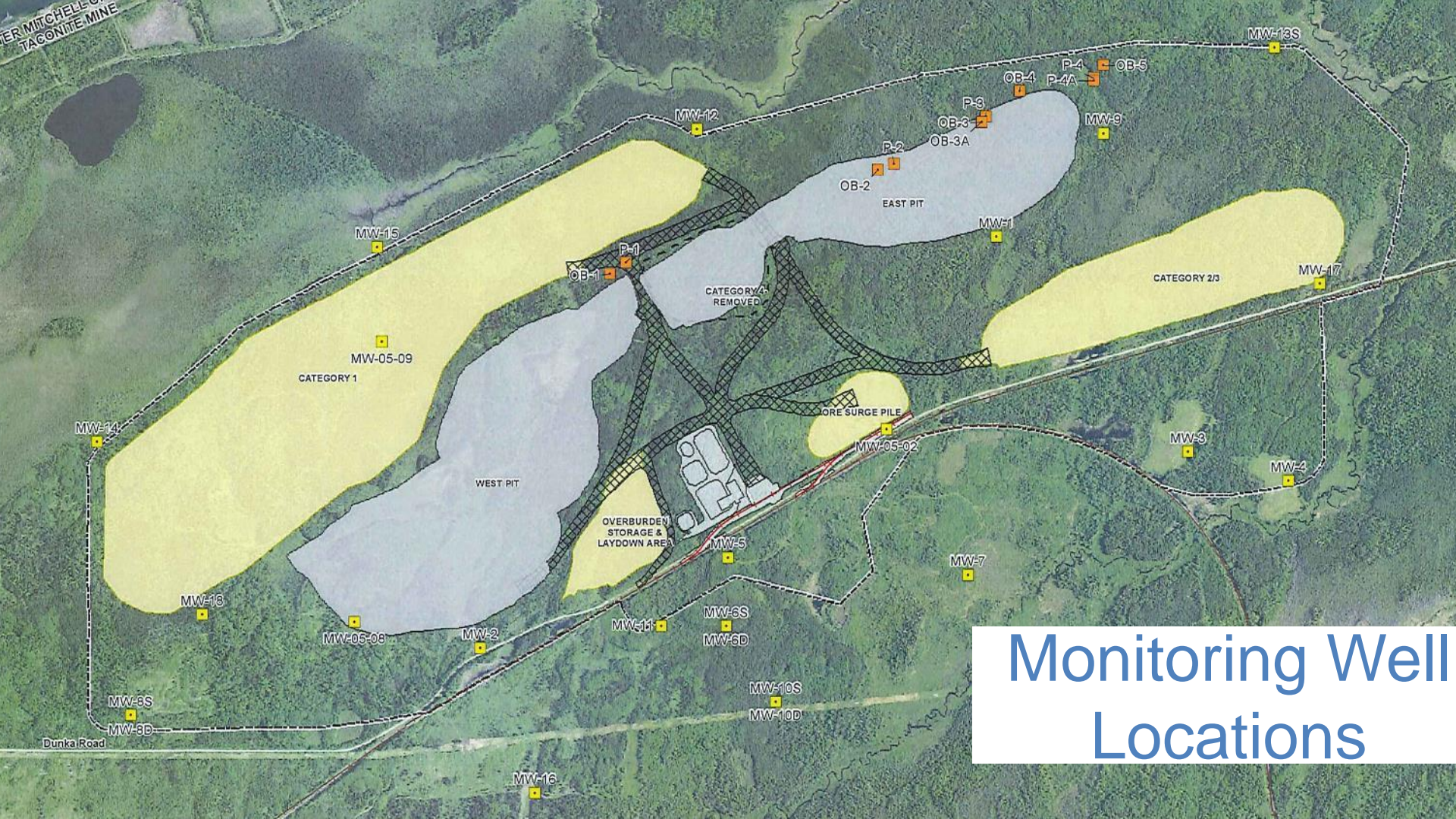


6/29/2015

PLM / POM



13



Monitoring Well Locations



Wild Rice Studies

6/29/2015

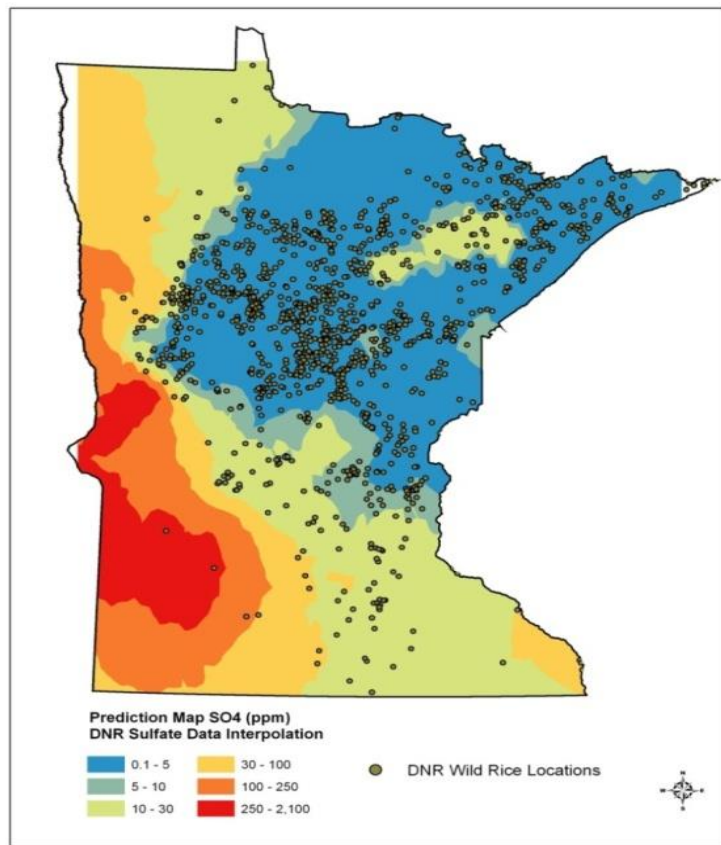
PLM / POM

15



Wild Rice Sulfate Standard

- MN Sulfate water quality standard (10 mg/L) adopted in 1973 to protect wild rice
- Sulfate standard is now being enforced on a case-by-case basis
- MPCA in process of researching and updating this standard



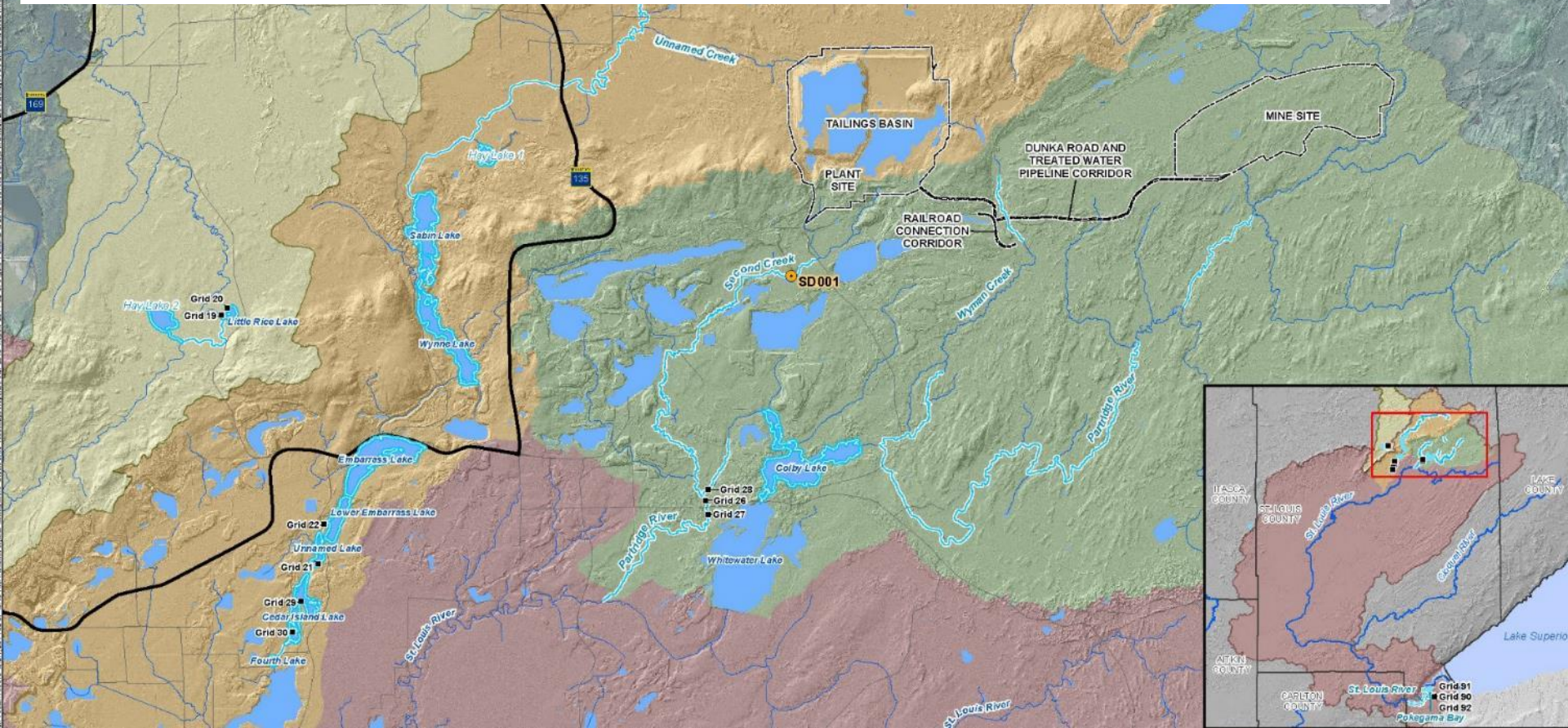
Program Objective

Document the presence of wild rice and some habitat conditions in water bodies downstream from the NorthMet Mine Site (the Project).

Program Scope

- Quantitative and Qualitative surveys of wild rice
 - Will have 7 years of data as of 2015
 - Data collected in the Embarrass, Partridge and St. Louis Rivers
- Sample collection
 - Conduct surveys each year at the same time in mid-late August
 - Statistically analyze the results

Wild Rice and Water Quality Survey

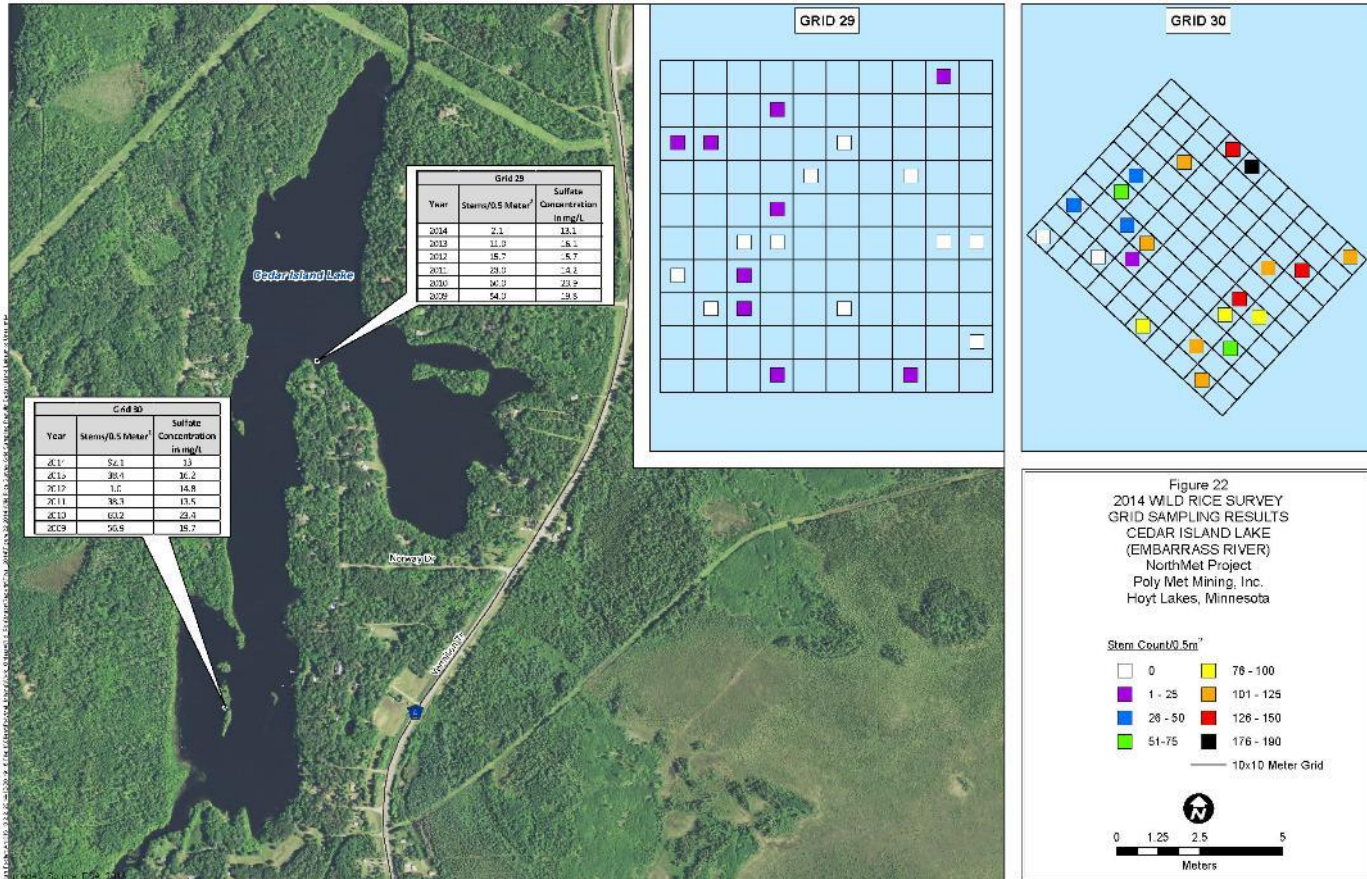


Lake Shoreline

- Surveyed over 2000 miles of shoreline over 6 years
- Other pertinent facts



Rice Density Surveys



Challenges

- Assessing wild rice health is difficult
- Difficult site access
- Many conditions affect the health of wild rice and a field survey is just one way to understand that issue

Unique Features of Data Set

- Very few data sets that are this long and this large
- Have a long term, repeated study of wild rice presence and some water quality conditions
- Data set shows a consistent and persistent wild rice population

Additional Study

- Examined the effect of landscape (river morphology and geology) on wild rice locations
- Wild rice locations appeared to have some correlation with “upland moraines” and are consistent with published descriptions of wild rice habitat – shallow, stable water levels, much substrates
- Many factors influence wild rice locations and growth - should not and cannot look only at water quality

Summary

- A variety of different types of data are needed to assess potential impacts of a mining project
- Presented just a few examples to highlight different types of data that PolyMet has collected
- Data extremely important to project controls and mitigation design